PATENTS
LT-5 REISSUE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION FOR REISSUE
OF U.S. PATENT 4,823,070

Date of Issue	:	April 18, 1989
Inventor	:	Carl T. Nelson
Title	:	SWITCHING VOLTAGE REGULATOR CIRCUIT
Assignee	:	Linear Technology Corporation
Reissue Serial No.	:	07/683,549
Reissue Filing Date	:	April 10, 1991
Examiner	:	Kristine L. Peckman
Group Art Unit	:	2102

March 9, 1995

Hon. Commissioner of Patents
and Trademarks
Washington, D.C. 20231

PETITION FOR EXTENSION OF TIME AND
RESPONSE TO EXAMINER'S ACTION

Sir:

Petition Under 37 C.F.R. § 1.136(a)
For Extension of Time

Pursuant to 37 C.F.R. § 1.136(a), applicant hereby petitions for a three-month extension of the shortened statutory period set for response to the Examiner's Action dated September 9, 1994. A check in the amount of eight-hundred seventy dollars ($870.00), in payment of the fee set forth in 37 C.F.R. § 1.17(c), is enclosed herewith.

Response to Examiner's Action

In response to the Examiner's Action dated September 9, 1994, applicant hereby amends the above-identified reissue patent application as follows:

In the Specification

Column 5, line 10, after "932,014" insert --(now U.S. Patent No. 4,755,741)--.

In the Claims

Please cancel claim 83 without prejudice.

Please amend claims 82, 86-87 and 89-91 as follows:

82.(Amended) An integrated circuit for implementing a current-mode switching voltage regulator circuit by connecting the integrated circuit to external components, the integrated circuit comprising:

at most five terminals, the terminals comprising input and ground terminals for connecting the integrated circuit to a source of input voltage and current, an output terminal for connecting the integrated circuit to an external inductive or transformer load, a feedback terminal for receiving an external feedback signal proportional to the regulated output voltage of the switching regulator, and a compensation terminal for connection to an external frequency compensation network;

a power switching transistor having its collector-emitter circuit coupled to conduct a current between the output terminal and the ground terminal;

means coupled to the switching transistor for varying the on and off duty cycle of the switching transistor in response to a control signal;

means including a resistive element coupled in series with the collector-emitter circuit of the switching transistor, and an amplifier coupled to the resistive element for generating a current sense signal indicative of the current conducted by the switching transistor;

means for generating an error signal indicative of a difference between the feedback signal and a reference signal;

means for coupling the error signal to the compensation terminal; and

means for comparing the current sense signal to the error signal and for generating the control signal to turn off the switching transistor when the current sense signal compares in a predetermined manner to the error signal to vary the duty cycle of the switching transistor to produce the regulated output voltage.

86. (Amended) An integrated circuit for implementing a current-mode switching voltage regulator circuit by connecting the integrated circuit to external components, the integrated circuit comprising:

at least an input terminal and a ground terminal for connecting the integrated circuit to a source of input voltage and current, an output terminal for connecting the integrated circuit to an external inductive or transformer load, a feedback terminal for receiving an external feedback signal proportional to the regulated output voltage of the switching regulator, and a compensation terminal for connection to an external frequency compensation network;

a power switching transistor structure coupled to conduct current between the output terminal and the ground terminal;

a driver circuit coupled to provide a base drive current to the switching transistor;

a circuit coupled to the driver circuit for varying the on and off duty cycle of the switching transistor in response to a control signal;

a circuit including a resistive element coupled in series with the current path in the switching transistor between the output terminal and the ground terminal and an amplifier coupled to the resistive element for generating a current sense signal indicative of the current conducted by the switching transistor;

a circuit for generating an error signal indicative of a difference between the feedback signal and a reference signal, and for coupling the error signal to the compensation terminal and to the driver circuit;

a reference circuit coupled to provide the reference signal to the circuit for generating an error signal;

a circuit for comparing the current sense signal to the error signal and for generating the control signal to turn off the switching transistor when the current sense signal compares in a predetermined way to the error signal to vary the duty cycle of the switching transistor to produce the regulated voltage, the comparing circuit further being responsive to control signals externally applied to the compensation terminal for performing at least one of (a) limiting peak current conducted by the switching transistor, and (b) variably limiting current conducted by the switching transistor as a function of time; and

a circuit for placing the integrated circuit into a shutdown state where the current drawn by the integrated circuit is reduced, including by deactivating the reference circuit; wherein:

the driver circuit is responsive at least in part to the error signal for causing the base drive current provided to the switching transistor to vary so as to increase the efficiency of operation of the switching transistor.

87.(Amended) The integrated circuit of claim 86, wherein the circuit for placing the integrated circuit into a shutdown state is responsive to a signal externally applied to the compensation terminal.

89.(Amended) An integrated circuit for implementing a current-mode switching regulator circuit by connecting the integrated circuit to external components, the integrated circuit comprising:

at least an input terminal and a ground terminal for connecting the integrated circuit to a source of input voltage and current, an output terminal for connecting the integrated circuit to an external inductive or transformer load, a feedback terminal for receiving an external feedback signal proportional to the regulated output voltage of the switching regulator, and a compensation terminal for connection to an external frequency compensation network;

a power switching transistor structure coupled to conduct current between the output terminal and the ground terminal;

a circuit coupled to the switching transistor structure for varying the on and off duty cycle of the switching transistor in response to a control signal;

a circuit, including a resistive element coupled in series with a current path in the switching transistor structure between the output terminal and the ground terminal and an amplifier coupled to the resistive element, for generating a current sense signal indicative of the current conducted by the switching transistor;

a circuit for generating an error signal indicative of a difference between the feedback signal and a reference

signal, and for coupling the error signal to the compensation terminal; and

a circuit for comparing the current sense signal to the error signal and for generating the control signal to turn off the switching transistor when the current sense signal compares in a predetermined way to the error signal to vary the duty cycle of the switching transistor to produce the regulated voltage, said comparing circuit further being responsive to control signals externally applied to the compensation terminal for (a) limiting peak current conducted by the switching transistor and (b) variably limiting current conducted by the switching transistor as a function of time,

wherein the integrated circuit terminals require connection to no more than five different nodes among the external components to implement a current-mode switching regulator circuit.

90. (Amended) The integrated circuit of claim 89, further comprising a circuit for reducing the current drawn by the integrated circuit to place the integrated circuit into a shutdown state.

91. (Amended) The integrated circuit of claim 90, wherein the circuit for reducing the current drawn by the integrated circuit is responsive to a signal externally applied to the compensation terminal.

REMARKS

Summary of Examiner's Action

Claims 1-92 were pending in this reissue application.

The Examiner has objected to the specification under 35 U.S.C. § 112, first paragraph, for failing to provide

support for the invention as now claimed. Claim 83 has been rejected under 35 U.S.C. § 112, first paragraph, for this reason.

Claims 86-88 and 90-92 have been rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter of the invention because two claim limitations refer to the same disclosed element.

Claims 86-92 also have been rejected under 35 U.S.C. § 251 as being broadened in a reissue application beyond the two year requirement.

The Examiner has also rejected claim 89 under 35 U.S.C. § 102(a) as being anticipated by the UC3842 integrated circuit pulse width modulator described in an article entitled "UC3842 Provides Low-Cost Current-Mode Control" (hereinafter "the UC3842 reference").

The Examiner further has rejected claims 86-88 and 90-92 under 35 U.S.C. § 103 as being obvious over the UC3842 reference, and further in view of a Texas Instruments reference relating to the Types RC4193 micropower switching regulators (hereinafter "TI regulators") and another Texas Instruments reference concerning the Type TL496C 9-Volt Power-Supply Controller (hereinafter "TI controller").

Claims 82-85 additionally have been rejected under 35 U.S.C. § 103 as being obvious over the UC3842 reference in view of the Lambda LSH6335P 3-Amp dc-to-dc microconverter (hereinafter "the LSH6335 reference," the Lambda LSH6355P 5-Amp dc-to-dc microconverter (hereinafter "the LSH6355 reference," Moreau U.S. Patent No. 4,532,522 (hereinafter "Moreau"), and Mashino U.S. Patent No. 4,680,530 (hereinafter "Mashino").

The Examiner has allowed claims 1-81.

Summary of Applicant's Response

The specification has been amended to identify U.S. patent application Serial No. 932,014, referred to at column 5, lines 10-13 of the '070 patent, as U.S. Patent No. 4,755,741. No new matter has been added.

Claims 82, 86-87 and 89-91 have been amended to more particularly point out and distinctly claim the invention. No new matter is added by any of the amendments. Additionally, claim 83 has been cancelled without prejudice, thus all rejections against that claim are now moot.* A supplemental reissue declaration is being submitted herewith.

Applicant's Response To
The Section 112 Rejections

The Examiner has rejected claims 86-88 and 90-92 under 35 U.S.C. § 112, second paragraph, for failing to particularly point out and distinctly claim the invention. The Examiner stated that the compensation terminal and the shutdown terminal are both claimed, but that the specification and drawings disclose them to be the same terminal and that two claim limitations cannot refer to the same element. This rejection is respectfully traversed.

There is no automatic rule against a claim having separately recited elements supported by a common structure. Instead, the governing considerations are whether the structure is adequately described by the specification and whether the claim is definite. See, e.g., In re Kelly, 305 F.2d 909, 916 (CCPA 1962) (holding that the simple fact that one or more

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* The Examiner has rejected claim 83 as not supported by the specification, and objected to the specification on this ground. Applicant disagrees with the Examiner's rejection, but nevertheless has cancelled claim 83 without prejudice in order to streamline and expedite to conclusion the prosecution of this reissue application. Because claim 83 has been cancelled, it is not further discussed in this Response.

disclosed structural elements performs more than one function common to elements separately recited in the claims does not prevent the claims from being sufficiently supported by the disclosure). Also see In re Knowlton, 481 F.2d 1357, 1368 (CCPA 1973) (where the Court rejected a contention that a single means-plus-function claim element can only be read on a single, complete mechanical element of the disclosed invention). Here, the claimed circuitry is both fully described and definite in view of the specification of the U.S. Patent No. 4,823,070 (hereinafter "the '070 patent") as originally filed.

The '070 patent specification describes an embodiment of applicant's invention in the exemplary system 100 illustrated in FIG. 1. An exemplary embodiment of the specific circuitry in question, namely the shutdown circuitry, is shown in greater detail in FIG. 4 (and described from column 11, line 62 thru column 13, line 13). As described in the specification, shutdown circuit 122 reduces the current flowing in the integrated circuit when the voltage level at terminal Vc is pulled below 0.15V. Although FIG. 1 shows that the shutdown terminal coincides with terminal Vc to provide a multi-function terminal (one other function of which is to provide for frequency compensation), nothing in the '070 patent specification states that this has to be the case. For instance, the patent states (at column 4, line 53-55) that:

> "a shutdown circuit may be connected to terminal Vc for placing regulator 100 into an inactive sleep mode in which the current drawn by regulator 110 is reduced to a very low value." (Emphasis added.)

Moreover, while it is true that some issued claims of the '070 patent recite a five-terminal integrated circuit having shutdown as one of the functions on those five terminals (see, for example, claim 76), it is also true that this is not recited in every claim. For example, claim 77 recites an

integrated circuit having at most five terminals, but does not require that shutdown be a function of any of those terminals. Similarly, issued claim 16 recites an integrated circuit that is not limited to having at most five terminals, and recites "a second function terminal for performing at least two of four different functions -- (1) frequency compensation, (2) peak current limiting, (3) variable current limiting, and (4) circuit shutdown. Clearly, claim 16 thus allows for a circuit to have five terminals or six terminals -- with a shutdown function being provided in combination with another function on a terminal of a five terminal or a six terminal embodiment, or alone or in combination with another function on a terminal of a six terminal embodiment.

Claims 86-88 and 90-92, as originally presented, thus were drafted in a form that follows the form and substance of the '070 patent's specification and other claims. Claims 86 and 90, in particular, were written such that the claimed shutdown terminal may or may not be the same as one of the other recited terminals of the claim -- in accordance with other claims of the '070 patent that provide for this possibility. This is made crystal clear by narrower claims 87 and 91, which specifically added that the shutdown terminal is the frequency compensation terminal.

Nevertheless, to avoid further dispute about the form of claims 86-88 and 90-92, applicant has amended claims 86-87 and 90-91 to delete references to a shutdown terminal. As amended, claims 86 and 90 still recite that the integrated circuit includes shutdown circuitry, but, in accordance with the disclosure of the '070 patent, do not specify that it must be connected to any particular terminal.* Amended dependent

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* Applicant has made additional amendments to claim 86 to more particularly define other circuitry in the claimed (continued...)

claims 87 and 91 recite that the shutdown circuitry is responsive to a signal externally applied to the compensation terminal (and, thus, are of comparable scope respectively to claims 87 and 91 as originally presented).

For at least the above reasons, the objection to the specification and the rejection of claims 86-88 under 35 U.S.C. § 112 should be withdrawn.

Applicant's Response to
The Section 251 Rejection

Claims 86-92 were rejected under 35 U.S.C. § 251 as being broadened in a reissue application more than two years after the '070 patent issued. The Examiner has asserted that because the supplemental declaration recites that the errors causing claims 86-88 to be added were not discovered until February or March 1994 (i.e., approximately five years after issuance), that those claims may not broaden the scope of the issued patent in this reissue application. This rejection is respectfully traversed.

The Examiner's rejection based on Section 251 is directly contrary to the guidelines set forth in the Manual of Patent Examining Procedure (hereinafter "MPEP"). Thus, MPEP § 1412.03 (Rev. 14, Nov. 1992) states:

> In a reissue application, filed within two years of the original patent grant, broadened claims may be presented even though such claims were not submitted until more than two years after the patent grant and were broader in scope than both the original patent

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*(...continued)
integrated circuit. These amendments include clarification that the shutdown of the integrated circuit includes deactivation of a reference circuit that generates the reference signal described in connection with the error signal circuit. The amendments to claim 86 also include recitation of a driver circuit coupled to provide a base drive current to the switching transistor (the driver circuit is discussed further below in the remarks concerning the Examiner's rejection of claim 86 over prior art), and a current sense amplifier. None of these amendments adds any new matter.

claims and broadening reissue claims originally submitted.

Moreover, the Examiner's Section 251 rejection is contrary to well-settled law. See e.g., In re Doll, 419 F.2d 925, 928 (CCPA 1970). In that case, the Court of Customs and Patent Appeals held that claims presented in a reissue application filed within two years of the original patent grant were not barred by 35 U.S.C. § 251, even though the claims were submitted more than two years after the original grant date and were broader in scope than the original patent claims and the broadening reissue claims.

The Examiner has correctly stated that applicant "met the two year requirement in filing broadened claims 82-85." Because that requirement is met, it is clear that applicant has the right to file additional broader claims at any time before the reissue application issues. Thus, applicant may present broadening claims 86-88, even though the presentation of those claims first occurred more than two years after the '070 patent issued.

For at least the foregoing reasons, applicant respectfully requests that the Examiner's rejections based on 35 U.S.C. § 251 be withdrawn.

Applicant's Response To
The Prior Art Rejections

Claim 82

The Examiner has rejected claim 82 as obvious under 35 U.S.C. § 103 from the UC3842 reference, in view of the LSH6335 and LSH6355 references, Moreau and Mashino, on the ground that it would have been obvious to reduce the number of terminals required by the UC3842 by deleting the five-volt reference, time constant and current sensing terminals. Applicant respectfully traverses this rejection because none of

these references, either alone or in combination, suggests to make these modifications to the UC3842. Indeed, the prior art suggests not to make these changes.

Claim 82, as amended, recites an "integrated circuit for implementing a current mode switching regulator," including (among other elements) an integrated power switching transistor, an integrated means including a current sense resistor, and an amplifier for generating a current sense signal indicative of current conducted by the switching transistor, and "at most five terminals" defined by the claim for connecting the integrated circuit to external components. The UC3842 does not include the claimed integrated switching transistor, does not include the claimed integrated current sense signal generating means, and -- as the Examiner has recognized (Office Action, p.6) -- "does not disclose at most five terminals." Indeed, although the UC3842 is an integrated circuit current-mode switching voltage regulator controller, the circuit requires eight terminals connecting the device to external components.

There is nothing in the UC3842 reference, or in any of the other cited references, that suggests to produce the integrated circuit current-mode switching regulator of claim 82 -- including nothing to suggest the deletion of three of the UC3842's eight terminals. In fact, the UC3842 reference itself demonstrates the non-obviousness of modifying the UC3842 circuit in ways necessary to delete these three terminals. The Examiner has cited to Mashino for its statement (column 5, line 58 to column 6, line 2) that reducing the number of terminals can simplify production steps and the cost of production and thus in support of the proposition that reducing the number of terminals in the circuit of the claimed invention to at most five terminals would have been obvious. The UC3842 reference,

however, states that the UC3842's eight terminal design resulted from a desire to achieve a design of "low cost" (see p. 71 of the reference). This directly contradicts the Examiner's assertion of obviousness. Although the designers of the UC3842 sought to reduce cost, still eight terminals were required for that circuit's implementation.

Furthermore, modifying the UC3842 to include the claimed integrated power switching transistor and the claimed integrated current sense signal generating means, and to reduce the number terminals to at most five, would require substantial changes in the general nature of the UC3842 that are inconsistent with its intended purpose. The UC3842 is a control IC designed to operate with an external power transistor of the user's choice. Internalizing the power transistor to handle substantially larger switch currents would require that the integrated circuit, and its package, be upgraded to handle the larger currents. The integrated power switching transistor, which is a very large device compared to other circuitry, also would require the chip area to be increased substantially. These factors all would add to the cost of the product.

At the same time, internalizing the power transistor would reduce the range of potential applications of the UC3842 by eliminating the user's choice of power transistor. For example, integration of a bipolar power transistor would, of course, preclude applications in which a MOSFET power switching transistor is desired. Yet, the design of the UC3842 as a control IC purposefully avoids this restriction -- indeed, the UC3842 reference points out that its output stage is "suitable for driving N Channel MOSFETs." Such teaching contradicts the supposed obviousness of modifying the UC3842 control IC to

convert it into a more costly, less flexible type of circuit by integrating the power switching transistor.

The non-obviousness of the integrated circuit current-mode switching regulator invention of claim 82, including the non-obviousness of reducing the number of terminals of an integrated circuit current-mode switching regulator to at most five, is further demonstrated by other current mode circuits known to be in the prior art. The UC1846/2846/3846 is another example of a current mode switching regulator controller circuit that previously was cited against the claims of the patent that is now being examined for reissue (see e.g., Unitrode Data Sheet "Unitrode UC1846 Current Mode PWM Controller Integrated Circuit," dated December 1983). The UC1846/2846/3846 includes an on-chip current sense amplifier (unlike the UC3842). Nevertheless, it still does not include other elements of claim 82 and, particularly, still requires the three terminals that the Examiner asserts would have been obvious to remove. Indeed, far from reducing the number of terminals, the UC1846/2846/3846 includes eight terminals more than the UC3842 (for a total of sixteen).

Nor do the LSH6335 or LSH6355 circuits support an assertion of obviousness. These devices are not current mode switchers. They are voltage mode switchers. What's more, as the cited references make plain, the LSH6335 and LSH6355 circuits are not monolithic integrated circuits. They are, instead, "micro-hybrid" circuits -- meaning that they include at least two integrated circuits, or an integrated circuit and another discrete component, incorporated within a single package. Nothing about these hybrid, voltage mode switchers suggests to create the invention of an integrated circuit current mode switching regulator control circuit having at most five terminals for connection to external components, as

recited by claim 82. The fact that five package terminals was achieved by Lambda for its voltage-mode switching regulator only by resorting to the use of a hybrid design, rather than by using a single integrated circuit, additionally demonstrates the non-obviousness of the invention of claim 82.

Finally, Moreau adds nothing to suggest the invention of claim 82. Moreau does not even disclose a switching regulator circuit. It describes, instead, a low dropout linear voltage regulator that uses a series-pass transistor scheme to regulate output voltage. Moreau's regulator, furthermore, is arranged in a conventional fashion to have three terminals (in the case of FIG. 4) or five terminals (in the case of FIG. 5). Integrated circuit series-pass linear voltage regulators having three or more terminals are, of course, well-known in the art. Integrated circuit current-mode switching regulator controllers having at most five terminals as claimed by claim 82, however, have not been known (to the best of applicant's knowledge). Certainly Moreau does not disclose or suggest one. Nor do any of the other references that have been cited by the Protester or the Examiner.

Claims 84-85

Each of claims 84 and 85 depends, directly or indirectly, from base independent claim 82. Because claim 82 is not unpatentably obvious, it necessarily follows that neither of claims 84 and 85 is obvious either.

Claim 86

Claim 86 has been amended to more particularly point out and distinctly claim the invention by the addition of a "driver circuit coupled to provide a base drive current to the switching transistor," the driver circuit being "responsive at least in part to the error signal for causing the base current provided to the switching transistor to vary so as to increase

the efficiency of operation of the switching transistor." No new matter has been added by these amendments. An exemplary embodiment of the claimed variable driver circuit is disclosed by the '070 patent (e.g., in FIG. 1, item 108) and, more particularly, by U.S. Patent No. 4,755,741 (hereinafter "the '741 patent"). The '070 patent specifically incorporates by reference the variable driver circuit of the '741 patent as an example of a driver circuit suitable for use with the circuit of the '070 patent. See the '070 patent at column 5, lines 8-13, where it is stated:

> "a driver circuit may be used of the type disclosed in co-pending patent application Ser. No. 932,014, filed Nov. 18, 1986, entitled 'Adaptive Transistor Drive Circuit,' filed in the name of Carl T. Nelson, the disclosure of which is incorporated herein by reference."

It is well-settled that a claim may properly be supported under 35 U.S.C. § 112 by subject matter disclosed in another issued U.S. patent that has been incorporated by reference in this fashion. See, e.g, MPEP § 608.01(p)B. (Rev. 15, Aug. 1993).

The Examiner's obviousness rejection of claim 86, as amended, is respectfully traversed because none of the references, either alone or in combination, discloses or suggests the claimed invention. None of the circuits in any of the cited references includes, or suggests to include, within an integrated circuit current-mode switching regulator controller a driver circuit that provides to the switching transistor a base drive that varies in response to the recited error signal.*

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* The variable drive circuitry of the '741 patent, that has been incorporated by reference into the '070 patent, has been a focus of two reexamination proceedings involving the '741 patent. See publicly available files of Reexamination Control No. 90/003,581 and reexamination Control No. 90/003,419. For the Examiner's convenience in examining this reissue application, and in accordance with the duty of candor, submitted herewith is a Supplemental Information Disclosure Statement identifying the references that have

(continued...)

Claims 87 and 88

Each of claims 87 and 88 depends, directly or indirectly, from base independent claim 86. Because claim 86 is not unpatentably obvious, it necessarily follows that neither of claims 87 and 88 is obvious either.

Claim 89

The Examiner asserts that the UC3842 anticipates claim 89 under 35 U.S.C. § 102(a). Applicant disagrees because there are limitations of claim 89 that are not met by the UC3842. For example, claim 89 recites a power switching transistor and a current sense resistive element as part of the claimed integrated circuit. The UC3842, however, does not include either of these elements as claimed. For this reason alone, there can be no anticipation.

Nevertheless, applicant has amended claim 89 to more particularly point out and distinctly claim the invention by the addition of the limitation: "wherein the integrated circuit terminals require connection to no more than five different nodes among the external components to implement a current-mode switching regulator circuit." No new matter has been added by this amendment.

Applicant has added this limitation to point out clearly that applicant's invention, as recited in the claim, is an integrated circuit controller chip for implementing a current-mode switching voltage regulator that, given the inclusion of the recited circuitry on the chip connected to terminals as described, is capable of being packaged in a conventional 5-pin power package (see, e.g., col. 4, lines 4-11). Prior integrated circuit controller chips for implementing current-mode switching regulator circuits, because

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*(...continued)
been made of record in the foregoing Reexamination proceedings.

of their design, could not be packaged in a 5-pin package. More than five different connecting points to external components were always required to implement a functional current-mode switching regulator circuit. For example, the circuit of the UC3842 requires at least six terminals connected to different nodes among the external components to implement a current-mode switching regulator circuit.

In contrast, the terminals of applicant's claimed integrated circuit require connection to no more than five different nodes among the external components to implement a current-mode switching regulator circuit. Of course, applicant's invention as defined by claim 89 also may be implemented using integrated circuits having more than five terminals within product packages having more than five pins. For example, functions such as external frequency synchronization may be added to the integrated circuit of claim 89 and connected to external components through an additional terminal and pin without departing from the invention of claim 89. The integrated circuit also may be provided with secondary ground terminals that are brought out to additional pins. Or, the integrated circuit additionally or alternatively may have a chip enable circuit connected via an additional terminal to yet another pin. Claim 89 still could cover such an integrated circuit despite the added terminals and pins, if a current-mode switching regulator circuit still could be implemented by connecting the integrated circuit terminals to no more than five different nodes among the external components.

As an example of the way in which applicant's claimed invention may be implemented using an integrated circuit within a package having more than five pins, the Examiner is referred to the attached datasheet for the Micrel MIC2172/3172 switching regulators. These integrated circuit products are packaged in

8-pin packages (see p. 2 of the datasheet). The pin functions include three grounds and a frequency synchronization or enable pin. Despite the presence of eight pins, however, the integrated circuits of the MIC2172/3172 products are capable of being packaged in a 5-pin package for connection to no more than five external nodes to implement a current-mode switching regulator. This is demonstrated in various circuit applications illustrated in the datasheet, wherein current-mode switching regulator circuits are implemented by connecting the integrated circuit terminals to no more than five different nodes among the external components of the current-mode switching regulator circuit. See, for example, FIG. 1 showing an MIC2172 in a boost converter circuit with the SYNC pin left unconnected and the ground pins P1, P2 and S all connected to a common external node. This circuit application thus illustrates one way in which the integrated circuit terminals of the MIC2172 require connection to no more than five different external nodes. Similarly, FIG. 13 shows the use of an MIC3172 in a buck converter circuit in which the enable pin is tied to the supply pin (V_{IN}) and the three grounds (P1, P2 and S) are tied together. This shows how the MIC3172 integrated circuit terminals require connection to no more than five different external nodes for implementation of a current-mode switching regulator circuit.

Thus, as illustrated by the MIC2172/3172 datasheet, an integrated circuit may have more than five terminals or be connected to more than five package pins, and yet still require connection to no more than five different nodes among the external components to implement a current-mode switching regulator circuit. This is because some of the terminals through the package pins can remain unconnected, or can be connected to one of the five external nodes. Such an

integrated circuit plainly is capable of being packaged in a 5-pin power package as described in the '070 patent and is within the scope of the amended reissue claim 89.

The non-obviousness of achieving applicant's claimed invention by modification of a known prior current-mode switching regulator controller (e.g., the UC3842) is supported by the same facts and reasons discussed above in the remarks concerning the Examiner's rejection of claim 82. Accordingly, the rejection of claim 89 under 35 U.S.C. § 102 should be withdrawn, and claim 89 should not be rejected under 35 U.S.C. § 103.

Claims 90-92

Each of claims 90-92 depends, directly or indirectly, from base independent claim 89. Because claim 89 is not unpatentably anticipated or obvious, it necessarily follows that claims 90-92 also are not obvious.

Conclusion

For at least the foregoing reasons, applicant respectfully submits that this reissue application, as amended, is now in condition for allowance. Reconsideration and prompt allowance of this reissue application, including claims 1-82 and 84-92, are respectfully requested.

Respectfully submitted,

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